BULLETIN

OF THE INSTITUTE OF METALS

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INSTITUTE NEWS

Powder Metallurgy Joint Group: New Publication.

The Powder Metallurgy Joint Group of The Iron and Steel Institute and The Institute of Metals was formed in 1957 to facilitate the study of the science, technology, and practice of powder metallurgy. Membership of the Powder Metallurgy Joint Group is restricted to members of the two Institutes, and it has been gratifying to the Councils of the two societies that the membership of the Group already exceeds 900.

The Group held its Inaugural Meeting in London on 4 December 1957 with a Symposium on "Developments in the Production and Quality of Metal Powders". This was followed by an Informal Discussion on 19 March 1958 on "Developments in the Practice of Compacting and Sintering". There was a very large attendance at both of these meetings.

It is intended that the Group shall hold two meetings each year, one in the spring and one in the winter. The first of the two meetings will normally be devoted to an Informal Discussion on a subject related to the industrial aspects of powder metallurgy, and the winter meeting to a Symposium or the discussion of other papers based on original research.

Originally it was intended that the papers on original work contributed to the meetings of the Joint Group should be published either in the *Journal of The Iron and Steel Institute* or in the *Journal of The Institute of Metals*, according to their subject, and that other papers, such as those contributed to the first two meetings of the Group, would not be published. It has now been agreed, however, by the two Councils that the papers contributed to the first two meetings of the Group are worthy of publication, together with summaries of the discussions that took place on them, and that there are important difficulties in the separation of the papers and reports of discussions as between the *Journals* of The Iron and Steel Institute and The Institute of Metals.

In consequence, the Councils of The Iron and Steel Institute and The Institute of Metals have now agreed that the papers contributed to the meetings of the Powder Metallurgy Joint Group, together with reports of the discussions on them and all other papers on powder metallurgy offered for publication to either of the two Institutes, shall be printed in a separate publication which will initially be published half-yearly, in the spring and autumn. Each issue of this publication will contain the papers to be discussed at the next meeting of the Group, together with a report of the discussion at the previous meeting and other papers on powder metallurgy that may have been accepted for publication. Those who receive the new publication can therefore secure, in good time for study, the papers to be discussed at the next Group Meeting.

Members will appreciate that the issue of this new publication, by joint effort, represents a new departure for both Institutes and a special service for those interested in a branch of metallurgy common to the members of both societies. In view of this, the Councils of the two Institutes have agreed that it is appropriate that those who receive the new powder metallurgy publication shall pay a fee as a contribution to the expenses of its production. The annual subscription price will be 25*s*. per annum, post free, to non-members, with a privileged rate of subscription to members of the two Institutes of 10*s*. per annum, post free. Those members of the two Institutes who subscribe to the new publication will be regarded as members of the Joint Group for the period of their subscription.

As the decision to issue this new publication has been taken so late in the year and because it is desirable that all the papers so far contributed to the Group proceedings shall be on record in printed form, a double number (1958, Parts 1/2) will be published this year (at the full annual subscription price); thereafter, until further notice, the publication will be issued half yearly.

The continued publication of papers on powder metallurgy in this form will depend on the support given by members of the two Institutes and by non-member (e.g. library) subscribers. The Councils of The Iron and Steel Institutes and The Institute of Metals therefore hope that every member now enrolled as a member of the Powder Metallurgy Joint Group will subscribe to the new publication and that many other members who have not yet joined the Group will also take the opportunity to subscribe to the new publication.

The administration of the Joint Group and the editorial responsibilities for the publication are undertaken by the staff of The Institute of Metals. All communications regarding the Powder Metallurgy Joint Group and subscriptions to the new publication should be addressed to the Secretary of the Powder Metallurgy Joint Group, Lieut.-Colonel S. C. Guillan, T.D., 17 Belgrave Square, London, S.W.1.

A circular regarding this matter, and an order form for the publication, are being despatched to all members of both Institutes, and it is hoped that orders for the subscriptions will be promptly received so that the first issue, containing the papers for the Symposium on "The Powder Metallurgy of Ceramic-Metal Materials", to be held at Church House, Great Smith Street, London, S.W.1, on 16 and 17 December 1958, will be received by subscribers in time for study before the meeting.

Powder Metallurgy Joint Group: Symposium on "The Powder Metallurgy of Ceramic-Metal Materials"

The next meeting of the Powder Metallurgy Joint Group will be held on Tuesday and Wednesday, 16 and 17 December 1958, when there will be a Symposium on "The Powder Metallurgy of Ceramic-Metal Materials".

At 6.30 p.m. on Tuesday, 16 December, Dr. P. Murray (Atomic Energy Establishment, Harwell) will give an introductory lecture. The main part of the Symposium will open at 9.30 a.m. on Wednesday, 17 December, and the meeting will end at approximately 5 p.m.

The following papers will be briefly presented and discussed:

E. Glenny and T. A. Taylor: "The High-Temperature Properties of Ceramics and Cermets".

R. Kieffer and F. Benesovsky: "Recent Developments in the Field of the Borides and Silicides of High-Melting-Point Transition Metals".

D. A. Robins: "Bonding in Carbides, Silicides, and Borides".

W. Watt: "The Oxidation of Zirconium Carbide in High-Temperature Combustion Gases".

J. B. Huffadine, L. Longland, and N. C. Moore: "Fabrication and Properties of Chromium–Alumina and Molybdenum–Chromium–Alumina Cermets".

P. Murray and J. Williams: A paper on bonded uranium oxide.

It is hoped there will be a large attendance. Non-members will be welcome at the meeting and tickets will not be required. Those who wish to take part in the discussion should give notification of the fact to the Secretary of the Joint Group at 17 Belgrave Square, London, S.W.1.

Monograph No. 23: "Vacancies and Other Point Defects in Metals and Alloys"

The six papers presented at the symposium on "Vacancies and Other Point Defects in Metals and Alloys", organized by the Metal Physics Committee and held at Harwell last December, have now been reprinted in monograph form, with a full account of the discussion.

The papers are:

"Point Defects and the Mechanical Properties of Metals and Alloys at Low Temperatures", by A. H. Cottrell.

"The Effect of Lattice Defects on Some Physical Properties of Metals", by T. Broom and R. K. Ham.

"Point Defects and Diffusion in Metals and Alloys", by W. M. Lomer.

"Point Defects and Mechanical Properties of Ionic Crystals", by P. L. Pratt.

"Point Defects near the Surface of a Metal", by E. C. Williams and P. C. S. Hayfield.

"Point Defects and the Mechanical Properties of Metals and Alloys at High Temperatures", by D. McLean.

The monograph, which is cloth bound and contains 240 pp., may be obtained from the Institute or through booksellers, price 40*s.* ($6.00) post free. Members may obtain one copy at the reduced price of 28*s.* ($4.40) post free, by direct application to the Institute.

"Metallurgical Reviews", Vol. 3

The three issues of *Metallurgical Reviews* published so far this year contain the following reviews:

"The Fabrication and Properties of Commercially Pure Beryllium", by J. Williams.

"The Lattice-Spacing Relationships in Alloys", by T. B. Massalski.

"The Fundamentals of Wire Drawing", by J. G. Wistreich.

"The Use of Radioactive Isotopes in Metallurgical Research and Industry", by A. Kohn.

"Fatigue of Metals Caused by a Relatively Few Cycles of High Load or Strain Amplitude", by P. P. Benham.

"The Mechanism of Diffusion in the Solid State", by C. E. Birchenall.

"Design from the Viewpoint of Corrosion", by W. D. Clark.

The fourth issue, now in the press, will contain:

"The Preparation of Metals for Protective Finishes", by R. E. Shaw.

"The Production of Sheet and Strip from Metal Powders", by G. Naeser and F. Zirm.

"Research on the Mechanical Properties of Metals at Liquid-Helium Temperatures", by H. M. Rosenberg.

Metallurgical Reviews, published quarterly by the Institute, is available only by annual subscription. The rates are: members 32*s.* 6*d.* ($5.00) post free and non-members 42*s.* 6*d.* ($6.50) post free.

PERSONAL NOTES

Mr. N. D. Benson has taken up an appointment with Western Copper Mills, Ltd., Vancouver, B.C.

Dr. G. F. Bolling has left the University of Birmingham and is now at the Westinghouse Electric Corp., Pittsburgh, Pa.

Mr. D. J. Brown has left Vickers-Armstrongs (Engineers), Ltd., and is now a research metallurgist with C. A. Parsons and Co., Ltd., Newcastle-on-Tyne.

Mr. F. T. Cleaver has been appointed Works Manager at the Huyton Quarry Works of British Insulated Callender's Cables, Ltd., Prescot, Lancs.

Mr. A. Day has left the Royal School of Mines and taken up an appointment with Bibiani (1927), Ltd., Bibiani, Ghana.

Mr. E. H. Dix, Jr., has retired from the post of Assistant Director of Research to the Aluminum Company of America which he had held since 1942.

Mr. H. A. Holden has been appointed Manager of the Metal Finishing Division of the Pyrene Co., Ltd., Brentford, Middlesex.

Dr. D. H. Houseman has been appointed Head of the Metallurgy Department at the Sir John Cass College, London.

Mr. H. D. Kessler is now Supervisor of the Product Development Division, Titanium Metals Corp. of America, Toronto, Ohio.

Dr. H. W. Meyer has left the Royal School of Mines and taken up an appointment in the Graham Research Laboratory, Jones and Laughlin Steel Corp., Pittsburgh, Pa.

Mr. N. H. Moseley has left Albert G. Sims, Ltd., Melbourne, and joined the Austral Bronze Company Pty., Ltd., Glenorchy, Tasmania.

Death

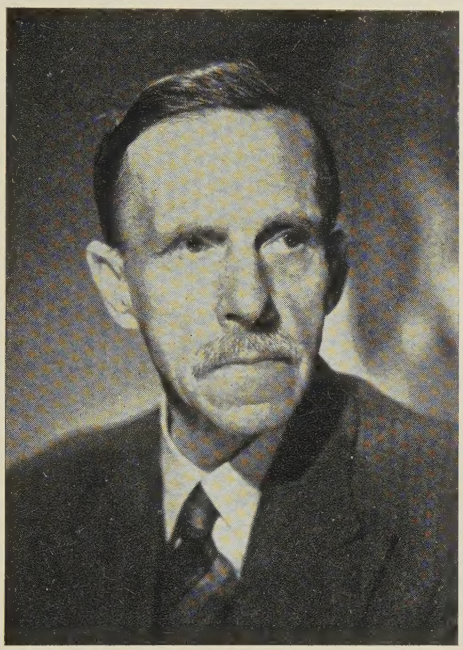
The Editor regrets to announce the death of:

Mr. Francis Bowyer Rice-Oxley, Managing Editor of *The Metal Bulletin*, on 18 August 1958.

OBITUARY

Dr. C. H. Desch, F.R.S.

Dr. C. H. Desch, who died on 19 June 1958, was one of the most outstanding, widely known, and universally respected figures in British and international metallurgy throughout the first half of the present century. His range of scientific knowledge extended far beyond the field of metals; indeed, he always regarded himself as primarily a chemist, and his continued interest in physical chemistry was evidenced in his



activities over many years in the Faraday Society. He had a wide knowledge of geology, archæology attracted his attention, and he devoted much thought and time to the science of sociology, which he hoped would lead to a synthesis of the arts and the physical sciences. He deplored the excessive specialization in education that tends to a narrow outlook in work and life. He was himself a man of wide culture; music and poetry were among his many interests, and he had a command of written and spoken English, elegant as well as forcible and concise, that is sadly lacking in a good deal of scientific writing. He was thoroughly at home in French and German, and some of us will always remember not only his contributions to scientific discussions but also graceful and fluent after-dinner speeches in these languages. He had, too, a useful knowledge of Italian and some other European languages.

Nobody knew Desch long without being impressed by his amazing range of exact and detailed scientific knowledge, together with its original sources. A keen mind, unwearying and most methodical industry, and a remarkably retentive memory were the foundations of this encyclopædic knowledge. He began to write abstracts of scientific papers, by no means limited to metallurgy, for several learned societies early in his career and continued this practice long after the responsibilities of the high positions to which he attained might seem to leave him little time for it.

Although simple in his tastes and habits to the point of austerity, Desch was a good talker and excellent company and he had a dry humour. The subject might be one of many—architecture and the preservation of the English countryside (about which he was deeply concerned) are examples—on which it was always worth while hearing what he had to say.

It is, however, as a metallurgist that Desch is remembered in the Institute of Metals, of which he was an Original Member. He read a paper on "Intermetallic Compounds" (a subject on which, in 1914, he wrote a useful book) at the first general meeting held in Birmingham in 1908 and, although not often as the author of a paper, he became one of the most familiar figures at the Institute's regular Spring and Autumn meetings and often spoke in the discussions. His vast knowledge and sound judgment made his comments on any paper well worth considering. He took a prominent part in the 1910 meeting in Glasgow, where he had recently been appointed University lecturer in metallurgical chemistry. Among the many friends he made in Glasgow were Professor Soddy and Sir George Beilby. Beilby and Desch had common interests in certain metallurgical problems, and it was fitting that Desch should undertake experimental work for the Institute's Beilby Prize Committee, the subject being the difficult one "The Solidification of Metals from the Liquid State", on which he made reports in 1914 and 1919.

From the first years of the Institute, Desch rendered notable service in abstracting French, German, and other foreign papers for the *Journal*. Abstractors' initials were first given in 1914, and from then until 1924 "C.H.D." appeared at the foot of a great many abstracts, indeed more frequently than any other initials in many volumes. From 1903 to 1918 he did similar work on a large scale for the Chemical Society's abstracts.

Desch gave the Institute's May Lecture in 1928 on "The Chemical Properties of Crystals", and it was characteristic of his modest and unassuming nature that, in referring to the researches of earlier May lecturers, he said that his was the humber task of the teacher. In the same year he was elected a Member of Council. He became a Vice-President in 1933 and President in 1938, his Presidential Address being "A Chemist's View of Metallurgy". He was awarded the Institute of Metals Platinum Medal in 1941 and elected a Fellow of the Institute in 1947.

The numerous lectures, addresses, and papers he gave to so many societies were often reviews of the subjects considered, characterized by abundant references, but always expressing an individual judgment and well-considered conclusions. It was a pleasure to listen to him giving a lecture or presenting or discussing a paper, in his clear, resonant voice and terse, scholarly English. He was a most attractive speaker.

Desch had a long and distinguished connection with the Iron and Steel Institute. He joined it in 1913, became a Member of Council in 1924, a Vice-President in 1930, Bessemer Gold Medallist in 1938, and was President from 1946 to 1948. He was elected an Honorary Member in 1950. He was the author of several papers and a frequent speaker in discussions. Metallurgy was one subject to him, and he was equally at home in the ferrous and non-ferrous fields.

In its concern with physical chemistry, the Faraday Society was highly congenial to Desch, whose name appeared in the first list of members in 1904; he spoke in the discussion of Beilby's paper "The Hard and Soft States in Metals" in that

year. In subsequent years he read several papers to the Society and took a prominent part in the General Discussions that have constituted such an important feature of the Society's work. He became a Member of Council in 1915, Vice-President in 1920, and was President from 1926 to 1928. His papers, addresses, and contributions to discussions illustrate the breadth of his scientific knowledge outside metallurgy.

Desch was also active for many years in the British Association for the Advancement of Science and a constant attender at its annual meetings down to 1951. He was a Member of Council in 1923–27, President of Section B (Chemistry) in 1925, Chairman of the Division for the Social and International Relations of Science in 1947, and became Chairman of the Sumerian Copper Committee, later Ancient Metal Objects Committee, in 1938. He undertook the microchemical analysis and other examination, one purpose of which was to ascertain the sources of the metals used, of large numbers of metal specimens from Ur, Kish, some American archæological sites, and other excavations. He made useful contributions to the history of science and technology; he was a member and became President of the Newcomen Society. The Society for the Preservation of Ancient Buildings benefited by his advice, and he was keenly interested in smoke abatement.

No account of Desch would be adequate without reference to sociology as one of his main interests. As early as 1900 he attended a ceremony in Paris in honour of Auguste Comte and there met Patrick Geddes, with whom he formed a lasting friendship: in 1932 he described Geddes as "the greatest teacher he had ever known". The Sociological Society, later the Institute of Sociology, was founded in 1903 by a group of distinguished men, of whom Geddes was one of the most active, and Desch joined at the beginning. He was a Member of Council of the Institute of Sociology for at least 30 years and its Chairman from 1940 to 1950. In his sociological papers and his many reviews of books, Desch's hope for "the union of scientific and humanistic studies" is constantly evident.

Not unconnected with this lasting interest in sociology was his faith as a positivist, adopted by him as a young man. Positivism, "the religion of humanity" founded by Comte, is one of high ethical ideals, consistently followed by Desch throughout his life, which was so largely devoted to the service of others in "his ardent longing to see a juster and nobler social order and an increasingly more dignified and worthy life for all human beings", as was truly said in the memorial address at his cremation. His unwavering outlook as a positivist never interfered, however, with his respect and consideration for the beliefs of others. His complete integrity in every aspect of life was outstanding.

Some chronological details may be added. Cecil Henry Desch was born in London in 1874 and, inspired at school with a love of science, became a student at Finsbury Technical College, where thorough teaching was combined with a disregard of examinations. Here he studied chemistry to such effect that at the age of 19 he was proposed for the Associateship of the Institute of Chemistry by the Professor, Raphael Meldola. He was granted this qualification on reaching the required age in 1895. His Fellowship followed in 1898. During these early years he often visited France, and especially Paris, with his father, who had a strong affection for that country.

His first post, as an industrial chemist, was in Stratford-on-Avon, where he lived for some years and became a confirmed Shakespearian. Further study and research in organic chemistry followed at Würzburg University (Ph.D.) and University College, London (D.Sc.), and his entry into metallurgy came when he joined the Metallurgical Department at King's College, London, in 1902; in 1909 he was appointed Lecturer in Metallurgical Chemistry at Glasgow University. In the same year he married Elison Ann, daughter of W. Ivison Macadam, Professor of Chemistry, Surgeons' Hall, Edinburgh, herself a chemist and previously a fellow worker at King's College. She often helped in his work throughout his active life, and he owed much to her in the preparation of his book "Metallography". First published in 1910 and reaching its sixth edition in 1944, this excellent work has played an important part in metallurgical education and has influenced successive generations of students. It has also been translated into German.

In 1918 Desch became Professor of Metallurgy at the Royal Technical College, Glasgow, and in 1920 succeeded J. O. Arnold as Professor of Metallurgy in the University of Sheffield. Here, in spite of financial stringency and consequent lack of equipment, as well as the need for large changes in the course to bring it abreast of the developments in metallurgy, he maintained a high standard of teaching and led a school of research. His lucid lecturing and power of exposition of difficult subjects were backed by encyclopædic knowledge. A good number of his Sheffield students in time became leading metallurgists, and he earned the devotion of many overseas students. He was elected a Fellow of the Royal Society in 1923. His lectures at Cornell University, U.S.A., in 1931, afterwards published as his book "The Chemistry of Solids", dealt mainly with metals and alloys. From 1932 to his retirement in 1939 he was Superintendent of the Department of Metallurgy at the National Physical Laboratory; his move to London enabled him to take a greater part in scientific affairs centred there.

In succeeding years he acted as adviser in research problems to the Iron and Steel Industrial Research Council, later merged in the British Iron and Steel Research Association, and to two large steel-making concerns; he served on the board of one of these for a time, but the duties of director of a company were not congenial to him. In 1947 his election as one of the few Corresponding Members of l'Académie des Sciences de Paris was an indication of the high esteem in which he was held abroad.

His widow and two daughters survive him.

HAROLD MOORE

Mr. F. H. Keating

Mr. F. H. Keating, Head of the Metallurgical Section of the Engineering Research Department at the Billingham Division of Imperial Chemical Industries, Ltd., died at his home on 16 August at the age of 57.

Frederick Hamilton Keating was born in Scotland and received his early training in Glasgow. After some time with Wm. Beardmore & Co., Ltd., he moved to a position with G. & J. Weir, Ltd. In 1933 he joined I.C.I. at Billingham and became a leading figure within the Company in the field of materials for chemical plants.

While his particular interests were the austenitic steels, stress corrosion, and the design and fabrication of chemical plant, his work covered a very wide field in metallurgy, and papers on very diverse topics came from him and from the section he controlled. He was well known to many firms in the country, and had travelled widely and given lectures on the Continent, in the U.S.A., and in Australia.

He took an early interest in the Institution of Metallurgists, of which he was a Fellow, and became a Member of Council. He was also on the Council of the British Welding Research Association, and he was a Governor of Rutherford College. For many years he served on committees of the British Standards Institution and the Engineering Equipment Users' Association.

He was a founder member and Past President of the North East Metallurgical Society.

LETTERS TO THE EDITOR

Renewed Creep in Lead–Thallium Alloys Prestrained by Extensive Tertiary Creep

It has been reported previously[1,2] that specimens of lead–thallium alloys develop a complex, interlocking grain structure after large extensions in creep (>100%). A few specimens (nine) remained sufficiently uniform in cross-section for them to be repolished after fracture to make new specimens (approx. 0·25 × 0·05 × 3 in.); this required 50 or more immersions in a polishing solution. The extent of the development of the interlocking structure appeared to increase with the amount of tertiary creep, which was greatest for thallium contents of 8–10%. The new specimens were loaded to initial stresses of 200 or 300 lb./in.^{2}, as in the corresponding original test.

The new creep curves were similar to the original ones, the ratio of old to new minimum creep rates varying from $\frac{1}{2}$ to $2\frac{1}{2}$ (Table I), whereas duplicates of the original tests were in the range 0·9–1·1. The changed rates were not due to variations in cross-section. During the new tests, up to 30% extension, all specimens (except No. 7) showed evidence of boundary sliding and grain tilting without any associated slip, deformation bands, or triple-point folds (see Fig. 1). The absence of slip was confirmed by phase-contrast microscopy. In the original tests all specimens had shown slip, bands, and folds in amounts related to the thallium content.[2,3] The extent of boundary migration in the new tests was less than in the original ones. Repolishing after 40% extension in the new tests showed no simplification of the interlocking grain structure. Specimen 7, which was unloaded early in tertiary creep in the original test, had a less complex structure and did show fine slip in the new test.

Table I.—*Original and Renewed Creep of Pb–Tl Alloys*

Specimen No.	Thallium Content, %	Initial Stress, lb./in.^{2}	Original Test		Renewed Creep Min. Creep Rate day^{-1} × 10^{-4}	Ratio of Original : Renewed Creep Rates
			Extension at Fracture, %	Min. Creep Rate day^{-1} × 10^{-4}		
1	2·35	200	185	5·3	2·7	1·9
2	4·81	200	189	9·2	3·75	2·45
3	7·87	200	170	8·25	7·0	1·18
4	13·45	200	280	6·7	12·0	0·56
5	4·35	300	186	14·1	9·5	1·48
6	4·35	300	190	5·6	7·3	0·77
7	4·81	300	115	12·0	13·6	0·88
8	19·8	300	202	4·5	9·4	0·48
9	19·8	300	213	3·05	5·8	0·53

Specimens 5, 6 and 7, 8 were not duplicates in the original tests, but had been differently heat-treated.[2]

X-ray back-reflection photographs of the original fractured specimens after repolishing showed a diffuse ring with slightly diffuse spots superimposed.[2,3] The renewed creep gradually removed the diffuse ring and sharpened the spots (see Fig. 2). Standing at room temperature for a similar period of time did not result in any similar sharpening.

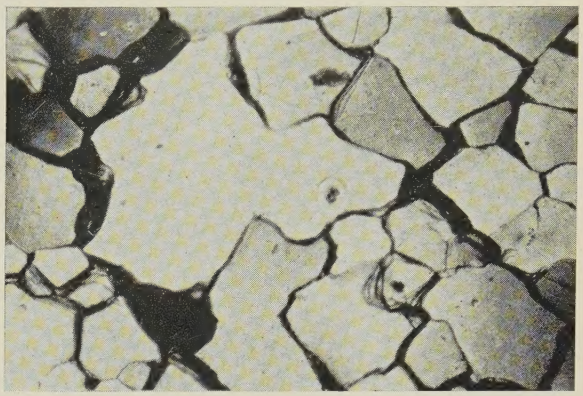


Fig. 1.—Lead–thallium alloy (specimen No. 5, 4·35% Tl); 18% extension in 166 days in renewed creep (previously extended 186% in original test). ×150.

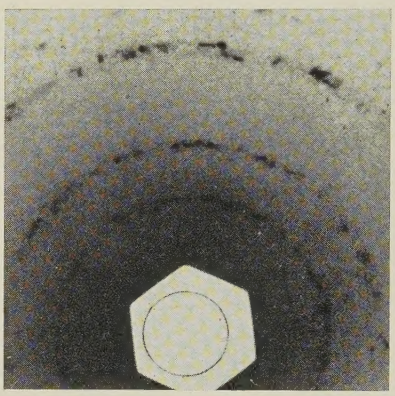


Fig. 2.—X-ray back-reflection photograph from lead–thallium alloy (specimen No. 2, 4·81% Tl) after 6% extension in 166 days in renewed creep.

It thus appears that the interlocking structure is a stable one during creep, which allows extension to proceed by grain-boundary sliding, without the production of optically visible slip; the X-ray observations confirm the absence of slip. Extensive tertiary creep seems necessary to produce this structure.

The behaviour of the specimens may be connected with the large amount of boundary migration which occurs during the large creep extensions; this might disperse impurities (especially oxygen) originally segregated to the boundaries.[4] This then allows boundary sliding and migration to alternate without building up local stresses and without producing coarse slip or folds. The other effect of extensive creep might be to assist in the stable arrangement of dislocations in "particle" walls (following Gay, Hirsch, and Kelly[5]). In the new tests, the lower stress, compared to that acting before fracture in the original tests, would allow (i) recovery, as indicated by the X-ray results, and (ii) dislocation movement to be limited to drift across the particles, i.e. any slip lines would be very fine and probably short. It is still not clear why the dislocations in the walls of such particles should not polygonize; an explanation

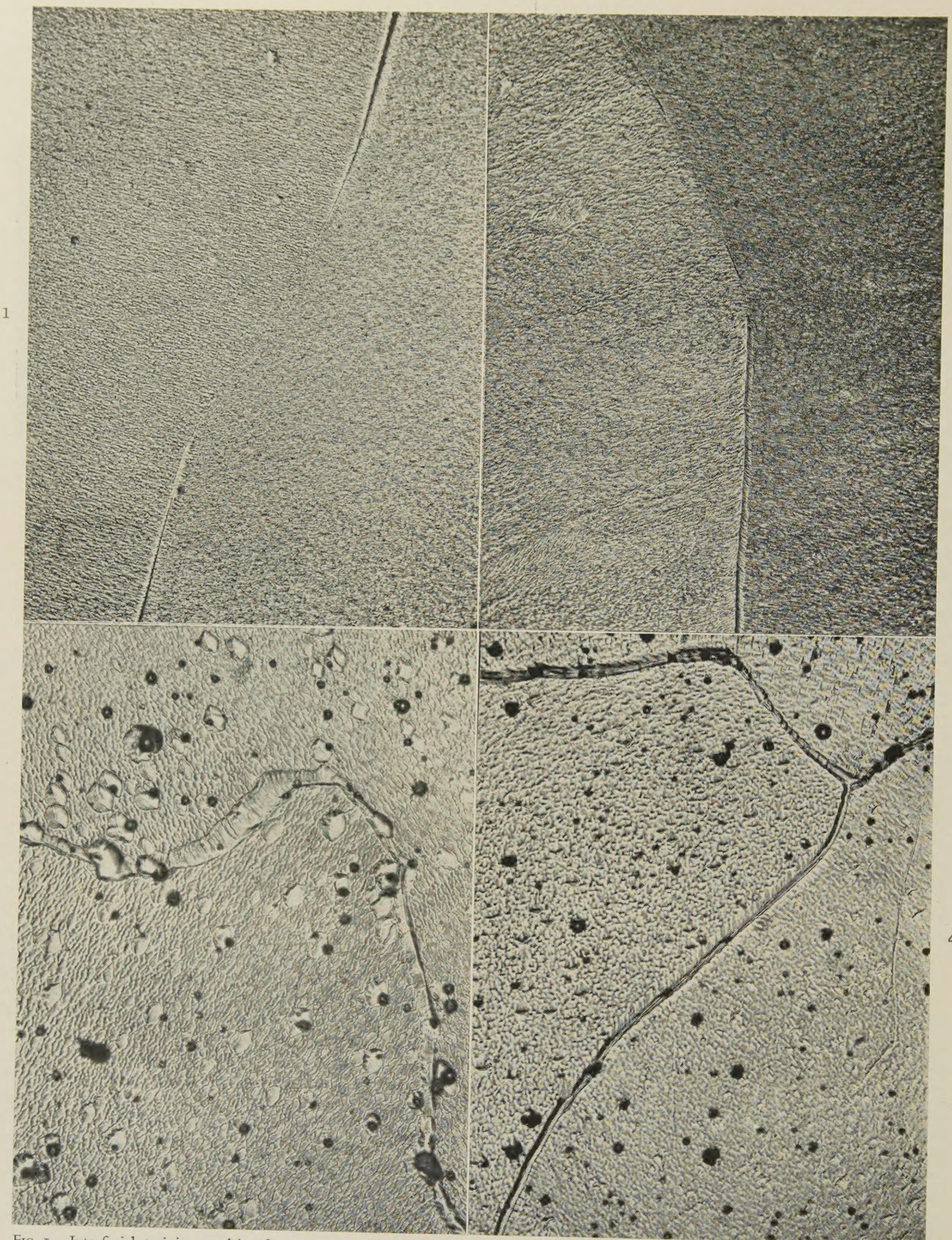


FIG. 1.—Interfacial straining resulting from sharing of atoms at the grain boundary in pure nickel (99·99%). Etchant: 10% ammonium persulphate and 10% potassium cyanide. ×500.

FIG. 2.—Another location in the same sample. ×500.

FIG. 3.—Similar straining at the grain boundary and precipitates in electrolytic iron saturated with oxygen. Etchant: 2% Nital and 4% Picral. ×750.

FIG. 4.—Another location in the same electrolytic iron sample. ×750.

Reduced by $\frac{1}{10}$ in reproduction.

probably awaits reliable information on the stacking-fault energy for lead and measurements of the particle size during creep.

R. C. GIFKINS

Physical Metallurgy Section,
C.S.I.R.O.,
Baillieu Laboratory,
University of Melbourne, Australia.

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2. R. C. Gifkins, *J. Inst. Metals*, 1953–54, **82**, 39.
3. R. C. Gifkins, *ibid.*, 1952–53, **81**, 417.
4. R. C. Gifkins, *ibid.*, in the press.
5. P. Gay, P. B. Hirsch, and A. Kelly, *Acta Cryst.*, 1954, **7**, 41.

Interfacial Straining Resulting from Sharing of Atoms

FIGS. 1–4 show photomicrographs of samples of as-cast metal which had been melted *in vacuo* in a high-frequency furnace. The metals are nickel (99·99%) and electrolytic iron saturated with oxygen resulting either from the existing rust or from oxygen absorbed in iron powder. Both metals are of the purest quality except for the oxygen content in the iron.

It is obvious that in the case of pure (unalloyed) metals there are no specific segregates at the grain boundaries. The atoms from adjacent grains are shared at the grain boundary. The lattice spacings will differ not only because of a difference in the crystallographic orientation of the grains but also because of the direction in which the boundary runs.

When in such cases large grains are examined, the displacement of the atoms at the interfaces (straining of the metal) will be revealed by etching, as the strained regions react differently from the rest of the grain. This displacement (expansion or contraction) can penetrate to a certain depth in the grain.

The same feature can be observed in the case of oxides which share metal atoms with the parent material.

Examples of interfacial straining at the grain boundary in nickel are shown in Figs. 1 and 2 and at the grain boundary and precipitates in electrolytic iron saturated with oxygen in Figs. 3 and 4.

The purpose is to show that deep etching or etch pitting reveals the location of strain, which changes with the orientation of the interfaces. Actual measurement shows that the affected grain-boundary region can extend to 25,000 Å. and more.

W. J. WRAZEJ

Physical Metallurgy Division,
Department of Mines and Technical Surveys,
Ottawa, Ont., Canada.

OTHER NEWS

International Symposium on the Physical Chemistry of Process Metallurgy, Pittsburgh, April 1959

An International Symposium on the Physical Chemistry of Process Metallurgy has been announced by Dr. John Chipman, President-Elect of The Metallurgical Society of A.I.M.E. and Professor of Metallurgy at Massachusetts Institute of Technology. This Symposium will be held on 27–30 April 1959, in Pittsburgh, Pa. It is being sponsored by The Metallurgical Society of A.I.M.E. in co-operation with the Physical Chemistry of Steelmaking Committee of the Iron and Steel Division, the Physical Chemistry of Extractive Metallurgy Committee of the Extractive Metallurgy Division, and the Melting and Casting Committee of the Institute of Metals Division.

The general topics for the four-day Symposium are:

I. *Physical-Chemical Principles*
   - A. Theory and behaviour of metal solutions and of oxide phases.
   - B. Electrochemistry: behaviour of fused salts and electrochemical reactions.
   - C. Pyrochemistry: reactions between slag, metal, gaseous, and solid oxide phases.

II. *Transport Phenomena*
   - A. Principles of kinetics; reaction rates, mass and energy transport.
   - B. Electrochemical phenomena. Electrode reactions and electrolysis.
   - C. Pyrochemical reaction mechanisms.

III. *Application of Physical and Chemical Principles to Metallurgical Processes—Thermodynamics, Kinetics, Mass and Energy Transfer*
   - A. Comminution.
   - B. Leaching, solution, and phase separation.
   - C. Roasting and agglomeration.
   - D. Reduction and smelting.
   - E. Gaseous-, liquid-, and solid-phase refining.
   - F. Casting and solidification.

IV. *Application of Operations*

Research and statistical methods to process control.

Technical papers in all fields of process metallurgy are invited for presentation at this Symposium. In addition to having reports on the results of new basic research, it is planned to emphasize in the programme the use of fundamental facts for obtaining a better understanding and better control of the new and the traditional methods for producing the various metals.

The deadline for submission of papers is 1 January 1959. Anyone wishing to participate in the Symposium should write to Professor John F. Elliott, Room 8–109, Massachusetts Institute of Technology. Cambridge 39, Mass., who is serving as Programmes Chairman. Professor C. Law McCabe, of Carnegie Institute of Technology, is Conference Chairman.

Proceedings of the Symposium will be issued.

Conference on Chipless Forming, Poznan, June 1959

The Metal-Working Division of the Polish Association of Mechanical Engineers is organizing a conference on problems relating to the chipless forming of metals and plastics, to be held during the 28th International Fair at Poznan in June 1959. The actual date has not yet been fixed.

The programme of the conference will embrace all aspects of chipless forming and in particular the following:

(1) Practical aspects of the theory of plasticity and theoretical bases of forming processes.

(2) Technology of cold- and hot-working processes.

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If you produce, extract, test, fabricate, design, or use metals in any way, this report of 49 experts on chromium can give you the most up-to-date and accurate information available today. Entirely new fields of usefulness for chromium and its alloys are forecast in this well-illustrated volume of proceedings at the important conference on Ductile Chromium co-sponsored by the Office of Ordnance Research, U.S. Army, and the American Society for Metals.

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Learn the importance of impurities in metals! Strangely enough, as this new authoritative book explains, if absolutely pure metals could and were to be substituted for the technical grades currently in use, the metal fabrication industries would be faced with many new and difficult problems! Learn how "Trace Elements" strangely influence mechanical properties and crystal growth of metals. Learn how these impurities influence the strength and ductility of metals!

In this review of fundamental considerations of residual elements, the authors expertly write of the effects these elements have on aluminum, magnesium, copper, nickel, steel, titanium, zirconium, molybdenum, and chromium. Learn how these metals are affected by residual elements. Learn how residual elements, produce favorable qualities and, just as frequently, adverse qualities! Attractively bound in red cloth and consisting of 217 pages, this book brings to you the up-to-date reports of five authorities. Easy to read and well-supplemented with charts, graphs, tables, and photographs, it will become a ready reference for designers, engineers, metallurgists and others whose job it is to know metals.

Make the knowledge of these experts *your* knowledge. Give yourself the advantage of being well-read on metals. Be capable of answering questions that before were only asked of others. Send today for *Effect of Residual Elements on the Properties of Metals*.

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(6) Historical development of metal-working technology.

The Executive Committee responsible for organizing the conference will welcome the participation of foreign engineers and invites papers to be read at the conference. All papers will be published. They should be based on scientific work or industrial experience.

Offers of papers should be sent to the Chairman of the Executive Committee, Professor F. Tychowski, Pl. Curie-Sklodowskiej 5, Poznan, Poland.

Plasticity of Production Processes

An intensive three-week course will be held at Imperial College from 20 April to 8 May during which the most important technological theories and researches underlying the major metal-working and machining processes will be considered. The course is intended for graduates in engineering, physics, or mathematics who are concerned with production processes and either require a refresher course in the principles of metal-working or have little or no knowledge of the subject. Many of the lectures will be given by experts from industry.

A more detailed announcement will be made in the technical Press at the beginning of 1959, although further details and application forms can be obtained now from the Registrar, Imperial College, London, S.W.7.

DIARY

Powder Metallurgy Joint Group

16–17 December. Symposium on "The Powder Metallurgy of Ceramic-Metal Materials." (Church House, Great Smith Street, London, S.W.1, at 6.30 p.m. on 16 December and at 9.30 a.m. on 17 December.)

Local Sections and Associated Societies

2 December. East Midlands Metallurgical Society. "Refining Nickel from the Sudbury Ores", by H. C. Castell. (Electricity Service Centre, Smithy Row, Nottingham, at 7.30 p.m.)

2 December. Oxford Local Section. "Inter-Planetary Travel", by Dr. L. R. Shepherd. (Cadena Café, Cornmarket Street, Oxford, at 7.0 p.m.)

3 December. Manchester Metallurgical Society. "Metallurgical Control in Mass Production", by J. E. James. (Manchester Room of the Central Library, Manchester, at 6.30 p.m.)

4 December. Leeds Metallurgical Society. "Thermodynamics in Metallurgy", by J. Lumsden. (Lecture Room C, Chemistry Wing, The University, Leeds 2, at 7.15 p.m.)

4 December. London Local Section. "The Continuous Casting of Bronze", by Dr. E. C. Ellwood. (Joint Meeting with the London Branch of the Institute of British Foundrymen.) (17 Belgrave Square, London, S.W.1, at 6.30 p.m.)

6 December. Liverpool Metallurgical Society. Annual Dinner.

8 December. Scottish Local Section. "Some Factors Affecting the Performance of Condenser and Heat-Exchange Tubes", by Dr. P. T. Gilbert. (Institution of Engineers and Shipbuilders in Scotland, 39 Elmbank Crescent, Glasgow, C.2, at 6.30 p.m.)

11 December. Birmingham Local Section. "Some Trends in American Metallurgy", by Dr. W. O. Alexander. (College of Technology, Gosta Green, Birmingham 4, at 6.30 p.m.)

11 December. Liverpool Metallurgical Society. "The Metallurgical Applications of High-Resolution Electron Microscopy", by Dr. J. Nutting. (Library of the University of Liverpool, 146 Brownlow Hill, Liverpool 3, at 7.0 p.m.)

11 December. North East Metallurgical Society. "Bearing Metals from the User's Point of View", by R. J. Brown. (Cleveland Scientific and Technical Institution, Corporation Road, Middlesbrough, at 7.15 p.m.)

11 December. Sheffield Local Section. "X-Ray Microscopy", by W. W. Nixon. (Engineering Lecture Theatre, The University, St. George's Square, Sheffield 1, at 7.30 p.m.)

11 December. Southampton Metallurgical Society. "Brazing", by E. V. Beatson. (Southampton University at 7.15 p.m.)

16 December. Birmingham Local Section. Christmas Lecture for School Children, by Dr. S. Harper. (Large Lecture Theatre, Physics Department, The University, Birmingham 15, at 2.30 p.m.)

16 December. South Wales Local Section. "Properties of Metals at Very Low Temperatures", by J. E. Aubrey. (Department of Metallurgy, University College, Singleton Park, Swansea, at 6.30 p.m.)

APPOINTMENTS VACANT

THE COLLEGE OF AERONAUTICS

LECTURER and DEMONSTRATORS required in METALLURGY or the MATERIALS SCIENCES, to teach at postgraduate level in specialized fields. There is a particular requirement for specialists in non-metallic materials or in metal technology, but other branches are relevant. Good facilities exist for research, and publication is encouraged. Demonstrators must be academically qualified and will, if suitable, be considered for subsequent promotion to Lecturer. A housing scheme is in operation at the College. Salary within scales: Lecturer £900 × £50–£1350 × £75–£1650; Demonstrator: £650 × £25–£1000; with F.S.S.U. and family allowances. Applications, including names of three referees, to: Recorder, The College of Aeronautics, Cranfield, Bletchley, Bucks. Further particulars available.

QUALIFIED METALLURGIST (age 21–28) required for interesting work in the development of sintered metal and allied products in an expanding process industry with well-equipped Laboratories. Good pension scheme. Please apply, giving full particulars of qualifications and experience, to Personnel Manager, Universal Grinding Wheel Co., Ltd., Stafford.

NOTICE TO AUTHORS OF PAPERS FOR THE "JOURNAL" AND CONTRIBUTORS TO DISCUSSIONS

1. **Papers will be considered for publication from non-members as well as members of the Institute.** They are accepted for publication in the *Journal* and not necessarily for presentation at any meeting of the Institute. MSS. should be addressed to The Editor of the *Journal*, The Institute of Metals, 17 Belgrave Square, London, S.W.1.

2. **Papers suitable for publication** may be classified as:

(*a*) Papers recording the results of original research.

(*b*) First-class reviews of, or accounts of progress in, a particular field.

(*c*) Papers descriptive of works methods, or recent developments in metallurgical plant and practice.

(*d*) Papers in classes (*a*), (*b*), and (*c*) above, previously published in languages other than English, French, German, or Italian, if of sufficient merit.

3. **Manuscripts and illustrations** should be submitted in duplicate. MSS. must be typewritten (*double-line spacing*) on one side of the paper only, and authors are requested to sign a declaration that neither the paper nor a substantial part thereof has been published elsewhere. Exceptions may be made in certain cases where a paper has been published in a language other than English, French, German, or Italian (see 2(*d*) above). MSS. not accepted are normally returned within 6 months of receipt.

In the interests of economy, all papers must be written as concisely as possible; in general, internal research reports are not in suitable form for publication as papers in the *Journal*. All but the simplest mathematical expressions should be written by hand, with capital and small letters clearly distinguished. Superscript and subscript letters should also be plainly indicated. Greek letters and special signs should be identified in the margin. For style, spelling, and abbreviations used, any recent issue of the *Journal* may be consulted.

4. **Abstract.** Every paper must have an abstract (not exceeding 250 words in length) which, in the case of a paper reporting original research, should state its objects, the ground covered, and the nature of the results. The abstract will appear at the beginning of the paper, and should be in a form suitable for use by abstracting organizations. Extracts from a "Guide for the Preparation of Abstracts" drawn up by the Abstracting Services Consultative Committee are reproduced below.

5. **References** must be collected at the end of the paper and must be numbered in the order in which they occur in the MS. Initials of authors must be given, and the Institute's official abbreviations for periodical titles (as used in *Metallurgical Abstracts*) should be employed, where known. References to papers should be set out in the style:

A. L. Dighton and H. A. Miley, *Trans. Electrochem. Soc.*, 1942, **81**, 321 (i.e. year, volume, page).

References to books should be in the following style:

C. Zener, "Elasticity and Anelasticity of Metals". **1948:** Chicago (University of Chicago Press).

6. **Illustrations.** Each illustration must have a number and description; only one set of numbers must be used in one paper. The captions should be typed on a separate sheet.

The set of **line figures** sent for reproduction must be drawn (about twice the size to appear in the *Journal*) in Indian ink on smooth white Bristol board, good-quality drawing paper, co-ordinate paper, or tracing *cloth*, which are preferred in the order given. Co-ordinate paper, if used, must be blue-lined with the co-ordinates to be reproduced finely drawn in Indian ink. Curves should be drawn boldly (i.e. at least twice the thickness of the frame). Experimental points should be indicated by open or closed circles, triangles, squares, &c. (preferably not crosses). Curves should be broken on each side of such symbols and plenty of allowance should be made for closing up in blockmaking. The Institute's standard lettering will be affixed, and ample margins must be left outside the framework of the figures to enable this to be done. The second set of line illustrations may be photostat copies.

Photographs must be restricted in number, owing to the expense of reproduction, and photomicrographs should be trimmed to the smallest possible of the following sizes consistent with adequate representation of the subject: 4 in. deep by 3 in. wide: 2 in. deep by 3 in. wide: 2 in. square. Magnifications of photomicrographs must be given in each case. Photographs for reproduction should be loose, not pasted down (and not fastened together with a clip, which damages them), and the figure number and author's name should be written on the back of each. Captions should be given to the photomicrographs, but these should be kept as brief as possible.

Because of the present high cost of printing and paper, it is imperative that authors restrict illustrations (particularly photographs) to the absolute minimum deemed necessary to support their argument. Only in exceptional cases will illustrations be reproduced if already printed and readily available elsewhere.

7. **Tables or Diagrams.** Results of experiments, &c., may be given in the form of tables *or* figures, *but* (unless there are exceptional reasons) *not both*. Tables should bear Roman numbers, and each should have a heading that will make the data intelligible without reference to the text.

8. **Corrections.** A certain number of corrections in proof are inevitable, but any modification of the original text is to be avoided. Since corrections are very expensive, the Institute reserves the right to require authors to contribute towards their cost if the Editor deems them to be excessive. The Institute also reserves the right to require a contribution to the cost of remaking any block where this is necessitated by an error on the author's part.

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GUIDE FOR THE PREPARATION OF ABSTRACTS

(*As recommended by the Abstracting Services Consultative Committee*)

1. **Purpose.** The abstract is not part of the paper; it is intended to convey briefly the content of the paper, to draw attention to all new information, and to the main conclusions. It should be factual.

2. **Style of writing.** The abstract should be written concisely and in normal rather than abbreviated English. It is preferable to use the third person. Where possible use standard rather than proprietary terms, and avoid unnecessary contracting.

It should be presumed that the reader has some knowledge of the subject, but has not read the paper. The abstract should therefore be intelligible in itself without reference to the paper; for example, it should not cite sections or illustrations by their numerical references in the text.

3. **Content.** The title of the paper is usually read as part of the abstract. The opening sentence should be framed accordingly and repetition of the title avoided. If the title is insufficiently comprehensive, the opening should indicate the subjects covered. Usually the beginning of an abstract should state the objective of the investigation.

It is sometimes valuable to indicate the treatment of the subject by such words as: brief, exhaustive, theoretical, &c.

The abstract should indicate newly observed facts, conclusions of an experiment or argument and, if possible, the essential parts of any new theory, treatment, apparatus, technique, &c.

It should contain the names of any new compound, mineral species, &c., and any new numerical data, such as physical constants; if this is not possible, it should draw attention to them. It is important to refer to new items and observations, even though some are incidental to the main purpose of the paper; such information may otherwise be hidden, though it is often very useful.

When giving experimental results, the abstract should indicate the methods used; for new methods the basic principle, range of operation, and degree of accuracy should be given.

4. **References.** If it is necessary to refer to earlier work in the summary, the reference should always be given in full and not by number. Otherwise references should be left out.

When an abstract is completed, the author is urged to revise it carefully, removing redundant words, clarifying obscurities, and rectifying errors in copying from the paper. Particular attention should be paid by him to scientific and proper names, numerical data, and chemical and mathematical formulæ.